COMBINED EFFECT OF 12-WEEK STRENGTH TRAINING AND SKILL TRAINING ON SELECTED PHYSICAL, PHYSIOLOGICAL VARIABLES AND PLAYING ABILITY OF HOCKEY PLAYERS

SHORT SYNOPOSIS

Submitted in partial fulfilment of requirement of the degree of

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(Deemed to be University)

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Certificate

I hereby declare that the short synopsis "COMBINED EFFECT OF 12-WEEK STRENGTH TRAINING AND SKILL TRAINING ON SELECTED PHYSICAL, PHYSIOLOGICAL VARIABLES AND PLAYING ABILITY OF HOCKEY PLAYERS" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Physical Education under faculty of Physical Education Lakshmibai National Institute OF Physical Education during the academic year 2021-2022.

It is a bonafide record of original work carried out under the supervision of Dr. N. Suhindar Singh and has not been submitted in full or part to any other university or institute for a degree or diploma. Further, it is certified that the short synopsis is plagiarism-free and the proof has been submitted.

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Abstract:

This study will examine the combined effect of a 12-week strength training and skill training program on selected physicaal, and physiological variables, and playing ability in male amateur hockey players aged 17–21 years from Assam, India. Forty-five participants were randomly divided to three groups: combined strength and skill training (n=15), skill training only (n=15), and a control group (n=15). Physical variables (speed, explosive power, agility, hand grip, muscular endurance, back/leg strength, flexibility), physiological variables (VO_2 max, resting heart rate, blood lactate, blood pressure, hemoglobin, body composition, forced vital capacity), and performance variables (dribbling, hitting, balancing) were measured before and after the training. The study aims to determine whether integrating strength training with skill training yields greater improvements in hockey performance compared to skill training alone, offering insights for optimizing training methodologies in the sport.

Keywords:

Strength training, Skill training, Hockey players, Physical fitness, Physiological parameters, Performance enhancement, Training intervention.

INTRODUCTION

Hockey is a globally recognized sport that is played on various surfaces including graass, artificial ground, or indoor courts. Each team has ten outfield players and one goalkeeper. Players use sticks—typically made from materials such as wood, fiberglass, or carbon fibre—to strike a hard, plastic ball. The length of the stick is usually proportionate to the player's height, reaching the hip. Only the flat side of the stick may connect the ball; using the other side is a not allowed. Goalkeepers may use specialized sticks with an extra curve for better control and surface area. Protective gear includes shin guards, mouth guards, and sport-specific attire.

This sport is especially popular in regions like Western Europe, South Asia, Australia, New Zealand, South Africa, Argentina, and parts of the U.S. In North America, the term “field hockey” differentiates it from ice hockey. In Scandinavia, it’s sometimes called "land hockey." Only goalkeepers are allowed to use their bodies to block the ball, while field players must rely on the front side of their stick. Connecting the ball with the other part results in a penalty.

Matches are won by scoring the most goals. Tied games may end in a draw, go to extra time, or be settled through a penalty shootout, depending on the rules of the competition. College formats may use sudden-death overtime and one-on-one shootouts.

The sport is governed internationally by the International Hockey Federation (FIH), which oversees major tournaments like the Olympics, World Cup, and Champions Trophy. Indoor hockey is a popular variant played with five players per side on a smaller, enclosed field. Key differences include restrictions on lifting or hitting the ball and using boards to keep the ball in play. Indoor sticks are also slightly lighter and thinner.

Historical Origins of Hockey

The origins of hockey date back thousands of years. Evidence suggests that primitive stick-and-ball games were played as early as 4,000 years ago in Egypt, and by the Greeks, Romans, and Aztecs in South America long before the arrival of European colonizers. These ancient forms of hockey were played under various names, but the basic concept of using a stick to control a ball remained consistent across cultures.

In medieval England, the game became highly competitive and was played between rival villages with teams consisting of up to 100 players. Matches were chaotic and often dangerous, prompting the need for

formal rules. In 1875, the Hockey Association was formed in England, laying down standardized regulations and giving umpires authoritative control over matches. These developments helped evolve hockey into a safer and more organized sport.

Emergence of Modern Hockey

Modern field hockey as we know it began to take shape in England during the 18th and 19th centuries. The game spread rapidly through British colonies, and schools such as Eton College were instrumental in refining its rules. The first Olympic hockey competition was held in London in 1908, and although it was temporarily dropped from subsequent games, it returned in 1920 and has remained an Olympic sport ever since.

The Fédération Internationale de Hockey (FIH), was formed following the refusal of the Paris Olympics organizers in 1924 to include hockey due to the lack of an international federation. Since then, hockey has seen exponential growth, with over 130 national federations under the FIH today.

Hockey in India: A Legacy of Excellence

Hockey holds a special place in Indian sports history. Before the British introduced organized hockey, traditional stick-and-ball games like *Khido Kunti* were played in Punjab. Modern hockey was introduced during British colonial rule, and Calcutta was the first Indian city to embrace the sport. The establishment of the Indian Hockey Federation (IHF) in 1925 marked the beginning of India's structured participation in international competitions.

India’s first appearance in 1928 Olympics in Amsterdam, where the national team won its first gold medal. India continued to dominate the sport, winning multiple Olympic golds and regaining the top spot again at the 1980 Moscow Olympics. The country added another milestone by winning the bronze medal at the 2020 Tokyo Olympics.

Physical Demands and Conditioning: Field hockey is a dynamic team sport that involves constant movement, rapid decision-making, and high-intensity sprints over a 60-minute match duration. Players are required to perform repeated bouts of explosive movements interspersed with periods of light activity. This places a significant demand on both the aerobic and anaerobic systems, requiring players to possess strong endurance as well as high-speed power.

Elite players need well-rounded physical conditioning including:

- Aerobic endurance to maintain high-intensity play.
- Anaerobic capacity for repeated sprints.
- Muscular strength and power for passing, shooting, and tackling.
- Flexibility and agility to evade opponents and execute quick directional changes.

Given the synthetic turf used in modern hockey, players also need to adapt to its different biomechanical demands. Conditioning must also focus on injury prevention, especially due to risks like spinal compression from high-impact movements on artificial surfaces.

Importance of Physical Training:

Field hockey is a sport that requires years of dedicated training to master both the technical aspects and the bio-motor physical qualities necessary for peak performance. These qualities include strength, endurance, and speed—all of which are vital for any elite-level player. As an endurance-based sport, field hockey demands cardiovascular stamina, muscular endurance, and explosive strength. Basic skills such as hitting, pushing, and scooping require arm strength, while the fast-paced nature of the game necessitates excellent running ability and the capacity to maintain performance over an extended period.

To build these physical attributes, various training methods are employed. For instance, circuit and weight training are effective for developing strength and muscular endurance (Seaton et al., 1983), while interval and resistance training are used to enhance speed and aerobic conditioning. The importance of a well-structured physical fitness program cannot be overstated, as it not only improves performance but also reduces the risk of injury.

Training must also be individualized, targeting specific weaknesses in a player's performance profile. A tailored training plan can ensure peak performance while minimizing the risk of overtraining.

Fundamental Technical Skills: Field hockey encompasses a variety of technical skills, each requiring precision, control, and practice. Among the most essential are:

Dribbling

Defined as the ability to maintain control of the ball while moving, dribbling is crucial for advancing the play and evading defenders. It requires coordination, speed, and finesse.

Passing

Passing involves delivering the ball accurately to a teammate using various strokes such as the push, hit, or scoop. Good passing builds momentum for attack and maintains team cohesion.

Shooting

Shooting is the act of sending the ball towards the goal, often from acute angles, with power and accuracy. Goal shooting determines scoring efficiency and is a decisive skill in match outcomes.

Pushing

Pushing is the quickest and simplest form of passing. It is effective for short, accurate passes and is commonly used in penalty corners and during open play.

Hitting

Hitting is a powerful stroke used to move the ball over long distances or take goal shots. Mastery of this skill allows players to clear the ball or launch an attack effectively.

Scooping

Scooping involves lifting the ball over an opponent, often used to bypass defenders and initiate aerial passes. It demands good timing, hand-eye coordination, and control.

Trapping (Stopping)

Trapping is the act of stopping or controlling the ball to prepare for the next movement. It plays a vital role in both offensive buildup and defensive interception.

STATEMENT OF THE PROBLEM:

The purpose of this study is to compare the effect of a skill training program combined strength trainingand skill training program on various performance indicators of hockey players

RESEARCH QUESTION:

Researcher will seek to find the answer to the following question:

1. Will there be a difference in physical variables as a result of the following two types of training (combinedskill and strength training and skill training)?
2. Will there be a difference in physiological variables as a result of the following two types of trainingintervention (combined skill and strength training and skill training)?
3. Will there be a difference in the playing ability of the players as a result of the following two types of trainingintervention (combined skill and strength training and skill training)?
4. If a difference is found, which training is better at improving the selected variables?
5. Which method will be the best in improving the performance of the hockey players?

OBJECTIVES OF THE STUDY:

1. To examine the effects of a skill training program combined with strength training and skill training on the performance, physical and physiological variables, of hockey players.
2. Find the differences in the effects of the combination of skill and weight training versus hockey training alone in all selected variables.

DELIMITATIONS:

The delimitation for the study :

1. The study is restricted to male hockey players of Assam.
2. The study will be delimited to male amateur hockey players of the under-seventeen year's age group.

3. The study includes 45 numbers of players.

4. It will be delimited to the following variables:

(i) Performance variables:

- Dribbling
- Hitting
- Balancing

(ii) Physical variables:

- Speed (50-meter dash)
- Explosive power (Broad jump)
- Agility (T-test)
- Hand grip (Hand dynamometer)
- Muscular endurance (sit-up/pull-up)
- Back/leg strength (leg-lift dynamometer)
- Flexibility (Sit and reach test)

(iii) Physiological Variables:

- Tidal volume (Spirometer)
- Force vital capacity (F.V.C)
- Vo2 max (copper run-walk test)
- Resting heart rate
- Blood lactate
- Blood pressure (sphygmomanometer)
- Hemoglobin
- Body composition (fat-free mass and fat %)

5. The study is delimitated to 12 weeks

LIMITATIONS:

- Different sports experience levels among participants.
- Uncontrolled factors like diet, medication, and daily habits.
- Weather conditions (temperature, humidity) and playing surface.
- Academic workload may affect motivation.
- Genetic and environmental differences between participants.

HYPOTHESES:

Based on a review of related literature and study materials and scholars' understanding, thefollowing hypothesis is formulated:

(i) It will be hypothesized that there will be no significant difference between skill training and combined strength and skill training in all selected variables

(ii) It will be hypothesized that there would be a significant difference between strength training combined skill training group skill training group, and control group irrespective of trainingduration in all the selected variables.

(iii) It will be hypothesized that there will be significant differences in the physical, physiological, andplaying ability of the hockey players due to combined strength and skill training

(iv) It will be hypothesized that there will be significant differences in the physical, physiological, andplaying ability of the hockey players due to skill trainin

DEFINITIONS AND EXPLANATION OF TERMS

Strength training: Strength training (or resistance training) focuses on physical exercises that build muscle strength and endurance. Although frequently linked to weightlifting, it also encompasses techniques such as calisthenics, isometrics, and plyometrics.

Skill training: skill training involves the training of skills related to the specific games designed to improve the basic skill of the game

Dribbling: A fundamental skill in hockey used for moving the ball helping in dodging the opponentsand keeping possession of the ball in control.

Hitting: A fundamental skill in hockey to pass the ball to the players and used for scoring goals in the game.

Speed: It is the measure of how fast an athlete or object moves from one position to another. It's calculated by dividing the distance covered by the time taken to travel that distance

Agility: Agility is the ability quickly and rapidly change direction without losing balance.

Force vital capacity: Forced vital capacity (FVC) is the maximum air you can blow out after a deep breath, usually about 4.8 liters since some air always stays in your lungs.

Vo2 max: It measure the highest amount of oxygen an individual used peak physical exercise.

Resting heart rate: It is the amount of heartbeat per minute while in rest, lower the heart beats per minute more efficient the heart of the individual.

Blood lactate: During exercise, muscles produce lactate, which builds up and causes fatigue.

Hemoglobin: Hemoglobin is a protein in red blood cells that carries oxygen to your body and removes carbon dioxide

Body composition: Body composition describes your body's makeup in terms of fat, muscle, and bone. It's divided into three parts: lean tissue (muscle/bone), body water, and fat.

SIGNIFICANCE OF THE STUDY

The study may help hockey coaches decide if strength training programs can be used for the development of hockey players.

- The result of this study provides information about the performa of hockey players involved in the study.
- This study might help coaches in preparing the preparatory phase or pre-season periodization of hockeytraining.
- This study might help coaches understand the significance and role of strength and power

training inhockey.

- This study might help in understanding the effects of strength training on players with no previous strengthtraining experience.

This study might provide a new insight for Indian hockey coaches in terms of the importance of strengthtraining for hockey players.

CHAPTER II

REVIEW OF RELATED LITERATURE

This research began with a detailed review of existing studies to clarify what's already known about the problem. The chapter organizes and summarizes key prior work—a critical step to avoid duplicating efforts and ensure a solid knowledge base**.**

(Kumar, R *et.al* 2019) A study to assess the impact of a 12-week training program on various physical fitness variables among young hockey players. Twenty-eight male players, aged 14.89 ± 1.66 years, underwent a structured training regimen focusing on strength, endurance, speed, flexibility, and coordination. Pre- and post-training assessments included measurements agility, maximum speed, shoulder strength, leg strength, and flexibility. Results revealed significant improvements in shoulder strength ($p < 0.01$), leg strength ($p < 0.01$), maximum speed ($p < 0.01$), and flexibility ($p < 0.05$) following the training period. However, CODS did not exhibit significant changes. These findings helps to understand the effect of 12- week training program in enhancing the fitness of hockey players, in terms of strength, speed, and flexibility. The study offers practical implications for coaches and trainers in designing effective training interventions to optimize players' performance and highlights the need for further research to explore task-specific training methods for improving CODS.

Srinivasan, P & Durai, C. (2018). The effect of core training on skill performance variables on hockey players.Thirty male hockey players aged 14 to 16 yrs. were recruited from LASA (Lakshmi Ammal Sports Academy) in Kovilpatti, Tamilnadu. Participants was categorized into two groups: Group I undergoes core training as the experimental group, while Group II served as the control. The training sessions were conducted threee days a week for six weaks. Before following the training period, participants undergo evaluation on skill variables, including dribbling (assessed using the W-form dribbling test) and goal shooting (evaluated with the Stewart Brothers Field Hockey Test). Statistical analysis using dependent 't' tests examined pre and post-test data for significant differences, with a level of significance set at 0.05. The study indicate a improvement in skill performance variables following the six-week core training compared to both the groups. Furthermore, significant differences wgere observed between the groups in terms of their performance outcomes.

(Churi, J. 2020). It was conducted to examine the impact of strength training on the playing capability

of inter-collegiate hockey players. Twenty-four (24) players were randomly selected from Sridora Caculo College of Commerce and Management Studies in Khorlim, Mapusa, Goa, with ages ranging from 18 - 27 years. The participants were categorized into two groups (12 players, comprising 6 males and 6 females). Group-I undergoes weight training, while other served as the control group and continued with their regular activities without any specialized training.

Playing ability was assessed before and after the training period using Munjal's Hockey Skill Test, which evaluated skills such as shooting, rolling, push, shuttle rolling, hit, sprint, scoop, pass, and flick. The data was analyzed using Analysis of Covariance (ANCOVA) with a level of significance set at 0.05.

The findings indicated that six weeks of weight training did not significantly improve the playing ability of experimental group in compared to control group. This suggests that weight training alone may not be sufficient to enhance hockey performance. Instead, a comprehensive training program incorporating skill development—such as speed with the ball and accuracy—should be emphasized to meet the game's demands. Additionally, longer training durations may be necessary to observe substantial improvements in player performance.

Thakur, J. K. (2023). It aimed to examine the influence of weight training on the playing capability of hockey players. For this research, 24 inter-collegiate hockey players (aged below 23 years) were randomly elected from R.T.M. Nagpur University, Nagpur. The participants were categorized into two groups of 12 (six males and six females). Group-I underwent weight training, while Group-II (the control group) followed their regular activities without additional training.

Playing ability was assessed before and after the training period using Munjal's Hockey Skill Test, which measured skills such as shooting, rolling, push, shuttle rolling, hit, sprint, scoop, pass, and flick. The data was analyzed using Analysis of Covariance (ANCOVA) at a 0.05 significance level.

The results showed that six weeks of weight training did not significantly enhance playing ability compared to the control group. This suggests that weight training alone may not be sufficient to improve hockey performance. Instead, a holistic training approach—incorporating skill development (such as ball speed and accuracy)—should be emphasized to meet modern game demands. Additionally, longer training durations may be necessary to produce meaningful performance

improvements in players.

B, B. M., & Jothilinggam, M. (2024). Field hockey is a physically demanding sport requiring a combination of strength, power, agility, and endurance. Players must execute explosive movements, rapid directional changes, and coordinated upper- and lower-body actions. While various training programs target these attributes, limited research exists on hockey-specific training for field hockey athletes. It aimed to evaluate the effects of a specialized training regimen on strength, speed, and agility in collegiate players. Thirty experienced hockey players (aged 18–25 years) from SIMATS, Chennai, with 3–4 years of competitive play, were selected. Baseline assessments included the 1RM squat (lower-body strength), 1RM bench press (upper-body strength), 10-meter DASH run (speed), and Illinois agility test. Participants were randomly assigned to two groups: one followed an 8-week, 4-day/week hockey-specific training program, while the other adhered to standard training protocols.

Post-intervention analysis using a t-test revealed significantly greater improvements in the hockey-specific group ($p < 0.0001$). These findings demonstrate that tailored training enhances strength, speed, and agility more effectively than generic programs. The study underscores the importance of sport-specific conditioning in optimizing hockey performance, suggesting coaches prioritize such regimens for athlete development. Future research could explore long-term adaptations and positional differences in training outcomes.

(Behringer. *et.al.* 2011) Current research confirms that resistance training is both safe and beneficial for children and adolescents. However, questions remain about how strength improvements from such training contribute to actual sports performance. A comprehensive meta-analysis found moderate overall improvements in fundamental movement skills (effect size = 0.52, 95% CI: 0.33-0.71), with specific gains in jumping (0.54), running (0.53), and throwing (0.99). The study revealed that younger, non-athletic participants showed more significant motor skill development than older or trained athletes. Interestingly, specialized resistance programs showed no superiority over conventional training approaches. The research also identified a dose-response relationship, where higher training intensity correlated with better performance outcomes, especially in groups using standard training protocols. These results collectively highlight the value of resistance training for developing motor competencies in youth populations

(Sharma, HB and Kailashiya, J. 2018) A six-week sprint-strength and agility training program was implemented with 24 elite Indian hockey players to evaluate its effectiveness on various physiological

and performance parameters. The condensed training regimen proved remarkably effective, producing significant improvements across multiple domains while maintaining efficiency. Players demonstrated favorable changes in the body composition with increased lean mass and less body ,along with enhanced cardiovascular markers including lowered resting heart rate and blood pressure. Performance metrics showed substantial gains in anaerobic power measured through sprint tests, explosive strength via vertical jump measurements, agility in the 505-test, and sport-specific skills like ball-hitting speed. Interestingly, the study revealed several important physiological relationships: improvements in vertical jump correlated with enhanced agility performance, while gains in seated shot-put performance aligned with increases in VO2max, which itself was associated with improved cardiovascular efficiency. Players with lower initial body weight and body fat percentage showed greater improvements in ball-hitting speed, and those with poorer baseline anaerobic-aerobic fitness demonstrated more pronounced gains in both ball speed and aerobic capacity relative to lean body mass. These findings provide valuable insights for coaches and trainers, demonstrating that targeted, short-duration training programs can effectively enhance multiple hockey-specific fitness components simultaneously. The results support the development of individualized training protocols based on athletes' specific physiological profiles, allowing for more precise programming and progress monitoring in elite hockey players.

(Faigenbaum. *et.al.*2014) It examined the effects of an 8-week integrative strength and skill-based training program during primary school PE classes. Forty-one fourth-grade students were divided into FIT (n=20) and control (n=21) groups. The FIT group performed 15-minute circuit training twice weekly, combining strength and skill exercises. Results showed significant improvements in the FIT group for aerobic capacity, push-ups, flexibility, and single leg hop, but not for sit-ups or long jump. No injuries occurred, demonstrating the program's safety. The findings suggest that short, integrated training sessions can effectively enhance multiple fitness components in children during regular PE classes, supporting the inclusion of combined strength and skill exercises in primary school physical education programs.

(V Vallimurugan. *et.al.*2022) This study evaluated the effects of combining strength training with basketball-specific skill drills on performance in college-level women's basketball players. Thirty players (aged 19–23) from Bharathiar University, Coimbatore, were categorized into two groups: an experimental group (Group-I) that underwent integrated strength and skill training, and a control group

(Group-II) that followed regular practice. The 6-week program, conducted 3 days/week, significantly improved dribbling, passing, and shooting skills (measured via AAHPERD Skill Test) in Group-I compared to Group-II. Statistical analysis (dependent t-test) confirmed these enhancements, demonstrating that structured strength training paired with skill development can effectively elevate key basketball performance metrics.

(Wong et al.,2010) This study evaluated the effects of combined 12-week strength and power training (CSPT) program on young soccer players' performance. Fifty-one U-14 athletes were divided into an experimental group (n=28) that performed CSPT twice weekly alongside regular training, and a control group (n=23). The CSPT program, targeting core and major muscle groups, yielded significant improvements ($p<0.05$) in multiple performance metrics.

Players demonstrated enhanced explosive power (vertical jump), technical skills (ball-shooting speed), and sprint performance (10m and 30m). The program also improved endurance (Yo-Yo test) while reducing running costs. Analysis showed moderate effects on vertical jump, ball-shooting, 30m sprint, and endurance, with smaller effects on 10m sprint and running economy. Significant correlations emerged between endurance and other metrics, including sprint times ($r=-0.43$ to -0.47) and ball-shooting speed ($r=0.51$).

These findings support integrating CSPT during preseason to simultaneously develop strength, power, speed and endurance without compromising aerobic capacity. The program appears particularly effective for youth athletes, though researchers recommend limiting it to preseason to avoid overtraining during competitive periods. This approach offers a comprehensive method for enhancing the multifaceted physical demands of soccer performance in developing players.

Ozbay, S. (2019) This study investigated how CrossFit and resistance training affect strength and body composition in recreational male athletes. Twenty-eight students were divided into two groups - one performing CrossFit's "Cindy" workout (20-minute AMRAP of pull-ups, push-ups and squats) and the other doing traditional weight training (3 sets at 70% 1RM) for 16 weeks. Both groups significantly improved in all strength measures (maximal, isometric and endurance) while reducing body fat without weight changes. Interestingly, CrossFit participants showed greater push-up performance gains despite shorter workouts. The results demonstrate that CrossFit's high-intensity functional training can match or exceed conventional weight training for certain strength improvements, offering a time-efficient alternative for recreational athletes. Both methods effectively enhanced strength and body composition,

with CrossFit particularly benefiting endurance-related strength. These findings suggest CrossFit may be especially valuable for time-constrained individuals seeking comprehensive fitness improvements. The study provides evidence that different training approaches can yield comparable results in recreational populations.

RAWTE, B. R., & YADAV, S. K. (2020). This study examined the impact of weight training on leg strength development in football players. Forty inter-university male players (20-26 years) from Guru Ghasidas University were divided into Group I and Group II. The group I performed a 6-week weight training program (1 hour/day, 5 days/week) including squats, leg press, lunges, and other leg exercises, while the group II maintained regular activities. Leg strength was measured using the standing broad jump test (AAPHER standards). Results demonstrated significant improvements in leg strength for the trained group compared to controls, confirming the effectiveness of structured weight training for football players' lower body development. The findings support incorporating targeted resistance exercises into football training regimens to enhance leg power essential for sport performace.

(Kumar. et. al,2004) The study examined the effects of plyometric combined with skill training on male volleyball players' performance. Sixty college athletes (18-25 years) from Coimbatore were divided into three groups: PLYOSKILL (n=20) performed both plyometric and skill exercises, SKILL (n=20) did skill training only, and CONTROL (n=20) maintained regular activity. After 12 weeks, the PLYOSKILL group showed significant improvements ($p<0.05$) in all measured parameters: jumping ability increased from 14.3±0.69 to 16.4±0.59 inches, anaerobic capacity improved from 780.9±54.12 to 818.2±44.2, and playing ability scores rose from 4.6±0.59 to 6.7±0.55. While the SKILL group also demonstrated gains (15.02±0.59, 800.2±28.25, 6.0±0.72 respectively), the CONTROL group showed minimal changes. These findings highlight that integrating plyometric exercises with skill training yields superior performance enhancements compared to skill training alone, particularly for developing explosive power and anaerobic endurance crucial for competitive volleyball. The results suggest coaches should incorporate both training modalities for optimal athlete development.

L. Santosh Singh et al;2018) The study examine the effects of plyometric versus weight training on physiological variables in elite football players. Sixty national-level male athletes from Manipur University were equally divided into three groups: Plyometric Training (Group I), Weight Training (Group II), and Control (Group III). The 12-week intervention involved four weekly sessions of progressive training for experimental groups, while controls maintained regular activities. Statistical

analysis (t-tests, $p<0.05$) revealed both training modalities significantly improved physiological measures compared to controls, with ANOVA confirming meaningful between-group differences in pre-post and adjusted means. The findings demonstrate that structured plyometric or weight training enhances football-specific physiological adaptations beyond regular practice. These results provide coaches with evidence-based options for periodized training programs to optimize player performance

Trzaskoma L, et al, (2010) It examined the effects of short-term combined conditioning training on leg strength and power development in 38 young active men. Participants were divided into four groups performing different combinations of weight training and pendulum swing exercises (32 dynamic bounces targeting lower body muscles). Measurements were taken immediately after and two weeks post-training, assessing 1RM squat, barbell squat jumps, countermovement jump (CMJ) power, and isometric strength of hip/knee flexors and extensors. Results showed significant improvements ($p\leq0.05$) in strength parameters when using combined training: 1RM squat increased by 10.2%, maximal torques by 23.2%, CMJ power (3,050.7±478.5 to 3,419.8±506.6W), and jump height (48.9±4.1 to 53.4±3.0cm). The seated pendulum swing position proved particularly effective, demonstrating that combining plyometric pendulum swings with traditional weight training offers an efficient method for enhancing muscle strength and power during short pre-season or in-season training cycles. These findings suggest this hybrid approach can optimize athletic performance when time-constrained.

Nuñez, J. et.al. (2021) This meta-analysis evaluated the impact of various strength training protocols on elite soccer players' short-sprint and vertical jump performance. Analyzing randomized controlled studies involving first-division professionals, researchers applied strict inclusion criteria regarding study quality, participant level, and performance metrics (countermovement jump and 10m sprint). Results revealed that different strength training approaches yielded comparable performance gains, with training timing proving more influential than specific methodology. Pre-season strength training demonstrated greater effectiveness than in-season implementation, likely due to fixture congestion limiting optimal training adaptation during competitive periods. The findings suggest that standalone strength training may not sufficiently enhance explosive performance qualities in elite players, highlighting the challenge of balancing sport-specific preparation with complementary strength work during demanding competitive schedules. These results emphasize the need for periodized, context-specific strength programming in professional soccer, particularly considering the constraints of the

competitive calendar.

CHAPTER III

PROCEDURE

The chapter presents the procedure for conducting the study and includes a detailed method of subjects selection , selecting the variaables, criterion measures, experimental design, administration of test, and the statistical techniques.

SELECTION OF SUBJECTS:

- The subjects were purposively chosen from a non-residential hockeyacademy based in, Assam.
- Forty-five male hockey players of 17-21 yrs. age group were selected for the study and then randomlyassigned to different groups
- Skill training group (n=15) (combined skill and strength training (n=15), control group (n=15)

SELECTION OF VARIABLES:

From the researcher's own understanding of the problem and based on literature review and discussionwith experts, the following variables were selected:

1. Independent Variables:
    - Skill training
    - Strength training
2. Dependent variables:
    - Physical variables
    - Physiological variables
    - performance

(i) Performance variables:

- Dribbling
- Hitting
- Balancing

(ii) Physical variables:

- Speed (50 mtr. dash)
- Explosive power (Broad jump)
- Agility (T-test)
- Hand grip (Hand dynamometer)
- Muscular endurance (sit-up/pull-up)
- Back/leg strength (leg-lift dynamometer)
- Flexibility (Sit & reach test)

(iii) Physiological Variables:

- Forced vital capacity (Spirometer)
- Vo2 max (copper run walk test)
- Resting heart rate
- Blood lactate (lacto spark measuring system)
- Blood pressure (sphygnomometer)
- Hemoglobin (Hemocue Hb201 DM System)
- Body Composition (fat free mass or fat %)

CRITERION VARIABLES:

Considering the purpose of the study and appropriateness of strength and skillTraining Exercises an Physical & Physiological and performance indicators to be assessed by the following variables, tests and their criterion measures were selected

SELECTION OF VARIABLES, TEST & CRITERION MEASURE

Category	Variables	Test Administration	Criterion Measures
Physical	Speed	50 mtr dash	Seconds
	Explosive power	Broad Jump	Meter
	Agility	T-test	Seconds
	Hand Grip	Hand dynamometer	Kg/newton
	Muscular endurance	Sit-up/pull up	Per minute
	Back /leg Strength	Leg-lift dynamometer	Kg/newton
	Flexibility	Sit and reach test	centimetre
Physiological			
	Vo2 Max	12 Minutes cooper /run/walk	meters
	Resting heart rate	Stopwatch (manually)	Beat/Min
	Blood lactate	Lacto Spark measuringsystem	m.mol/L
	Blood pressure	sphygmomanometer	Mmhg
	Haemoglobin	HemoCue Hb201DMSystem	m.mol/L
	Body composition (fat free mass and fat %)	Maltron ,Bioscan 916	Percentage
	Force vital capacity	spirometer	litres
Performance	Dribbling	Sai hockey skill test	score
	Hitting	Sai hockey skill test	score
	Balancing	Sai hockey skill test	score

ADMINISTRATION OF TEST

PHYSICAL VARIABLES:

Speed: To evaluate the speed of the subjects 50 mtr. dash will be conducted and stopwatch will be used to measure their timing in seconds.

Explosive power: To evaluate the explosive power standing broad jump will be conducted the subjects should perform the jump while standing and the maximum distance covered will be recorded, all the subjects will be given three chances and the best will be noted.

Agility: To evaluate the agility of the subjects the students have to perform the "t test" where therewill be 3 cones placed in t shaped and on the whistle go the students have to run complete the test and everyone will be given two chance and best will be recorded.

Hand grip: To measure the hand grip of the subjects hand dynamometer will be used and it willmeasure in kg/newton.

Muscular endurance: To test the muscular endurance of the subject's sit-up test will be

conductedand the maximum sit-up that the students can perform in 1 minutes will be counted.

Back/leg strength: To test the back/leg strength of the subjects' leg-lift dynamometer will be used andit will measure in kg/newton.

Flexibility: "sit and reach test" is conducted to evaluate the flexibility of the subjects and it willbe measure in cm.

PHYSIOLOGICAL VARIABLES:

Vo2 Max: To evaluate the vo2 maximum ,12 minutes cooper run/walk field test will be conducted and it will be measure by distance covered by the subjects.

Resting heart rate: Resting heart rate will be measure manually using stop watchand the beats per minute will be measured.

Blood lactate: The lactate concentration of the subjects will be measure using the lacto spark measuringsystem and it will be measure in m.mol/l.

Blood pressure: The blood pressure of the subjects will be measure using the sphygmomanometer andit will be measure in Mmhg.

Haemoglobin: To measure the haemoglobin of the subjects HaemoCue Hb201DM system will be used and it will be measure in m.mol/l.

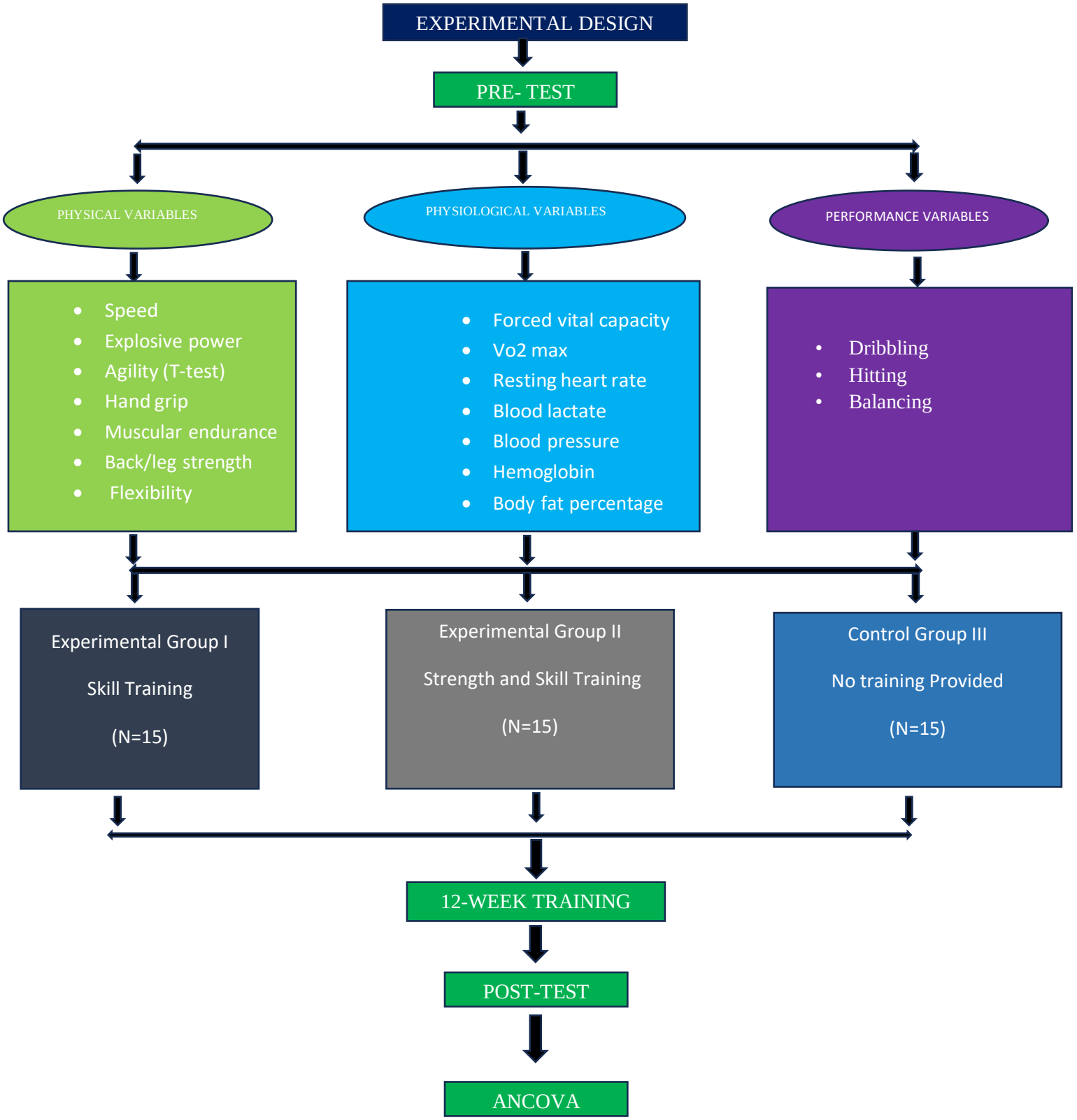
Body composition (fat free mass and fat %): To evaluate the body composition Maltron Bioscan 916 will be used and it will be measure in percentage.

Force vital capacity: To evaluate the force vital capacity of the subject's spirometer will be used and itwill be measure in litres.

PERFORMANCE VARIABLES:

The check the performance inicators of the subject's "Sai hockey skill test" will be conducted consisting of the threeitems dribbling, hitting and balancing.

EXPERIMENTAL DESIGN:


EXPERIMENTAL DESIGN
PRE- TEST
PHYSICAL VARIABLES
PHYSIOLOGICAL VARIABLES
PERFORMANCE VARIABLES
Speed
Explosive power
Agility (T-test)
Hand grip
Muscular endurance
Back/leg strength
Flexibility
Forced vital capacity
Vo2 max
Resting heart rate
Blood lactate
Blood pressure
Hemoglobin
Body fat percentage
Dribbling
Hitting
Balancing
Experimental Group I
Skill Training
(N=15)
Experimental Group II
Strength and Skill Training
(N=15)
Control Group III
No training Provided
(N=15)
12-WEEK TRAINING
POST-TEST
ANCOVA

COLLECTION OF DATA:

The data will be collected as scheduled given below;

- Day 1: Physiological variables
- Day 2: Physical variables
- Day 3: Playing Ability

Physiological variables will be tested on day 1, Physical variables on day 2, while playing ability will be tested on day 3 before and after the administration of training

STATISTICAL TECHNIQUES:

With a fixed 0.05 level of significance, the following statistical tests/techniques will be used.

1. Descriptive statistics will be used to compare mean, median, and standard deviation.
2. Analysis of Variance and Covariance (ANCOVA) will be used since participants were randomly assigned rather than matched. If the F-test shows statistically significant results ($p < 0.05$), the Least Significant Difference (LSD) post-hoc test will then be applied to identify which specific group pairs differ significantly from each other.

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